

Remarks

In view of the above amendments and the following remarks, the Examiner is respectfully requested to withdraw the rejections and allow claims 1-20, as well as newly introduced claims 21-23, the only claims pending and under examination in this application.

Formal Matters

The specification has been amended to correct obvious typographical errors in the application as filed. These errors are readily apparent from the application as a whole, as well as the claims as filed.

Figure 2 has been amended to remove an erroneous terminal vinyl group from molecule 5. Molecule 5 now shows the appropriate structure for the portion that is derived from molecule 3B. Support for this amendment is found in the structure of molecule 3B, which does not have a terminal vinyl group.

Claim 1 has been amended to specify that the constituent molecules of the ordered composite structure are held together by non-covalent interactions. Support for this claim can be found on page 6, line 2. Claim 1 has also been amended to specify the covalent bonding functionality as a cross-linking functionality. Support for this amendment can be found throughout the specification, as, for example, on page 15, lines 26-27. Claim 2 has been amended to specify the nanoporous structure as having two or more nanopores. Support for this claim can be found on page 17, lines 6-12. Newly introduced Claim 21 and Claim 23 find support in the specification on page 7, lines 24-26. Newly introduced Claim 22 finds support in Claim 3. As the above amendments introduce no new matter to the application, their entry by the Examiner is respectfully requested.

It is noted that claim 3 is not included in any prior art rejection and thus appears to be held by the Examiner to be patentable above the prior art.

Rejection Under 35 U.S.C. § 112, First Paragraph – Enablement

Claims 1-20 were rejected under 35 U.S.C. 112, first paragraph, for the asserted reason that the specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to carry out or make the invention commensurate in scope with these claims. Without in any way agreeing with the Examiner, the claims have been amended to specify that the first and second molecules self-assemble into an ordered composite structure made up of the first and second molecules held together by non-covalent interactions. As such, the claim does not include a method of using “any” first and second molecules, but a well defined class of molecules that is well supported by the specification. The scope of the claims is fully supported by the specification and Claims 1-20 are adequately enabled by the specification. Accordingly, the Applicants respectfully request that the rejection of Claims 1-20 under 35 U.S.C. § 112, first paragraph be withdrawn.

Rejection Under 35 U.S.C. § 112, Second Paragraph – Indefinite

Claims 1-20 were rejected under 35 U.S.C. § 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter of the invention. Specifically, Claim 1 recited the limitation “said covalently bonding functionality” without sufficient antecedent basis (Page 3, Office Action). The amended claim now recites the limitation “said cross-linking functionality,” which does have sufficient antecedent basis, found in step (a). As such, this issue has been addressed. In light of this amendment, the objection to Claim 1 under 35 U.S.C. § 112, second paragraph, may be withdrawn.

Claim 3 was rejected under 35 U.S.C. § 112, second paragraph as being confusing, specifically for the asserted reason that “[n]ot only the recitation ‘said two or more nanopores’ lacks antecedent basis, the meaning of this recitation is not understood since it is not defined anywhere in the specification” (Page 3, Office Action). As amended, Claim 2 limits said nanoporous structure as having two or more nanopores. This amendment provides antecedent basis for the recitation of “two or more nanopores” in

Claim 3. In light of this amendment, the rejection of Claim 3 under 35 U.S.C. § 112, second paragraph, may be withdrawn.

Rejection Under 35 U.S.C. § 102 (e)

Claims 1-2, 5-11, and 13-20 were rejected under 35 U.S.C. 102(e) as being anticipated by US Patent 6,653,358 to Bruza et al., (hereinafter Bruza). In making this rejection, the Examiner asserts that: (a) the reference discloses a method of forming nanoporous structures; (b) the reference expressly teaches that the matrix and the porogen molecules can be self-assembling molecules; and (c) the illustrative examples disclose sheets and nano objects as structures obtained from the method taught by patentee (page 4, Office Action). These rejections are respectfully traversed in view of the following remarks.

“Anticipation under 35 U.S.C. § 102 requires the presence in a single prior art disclosure of each and every element of a claimed invention.” *Electro Med. Sys. S.A. v. Cooper Life Sciences, Inc.*, 32 U.S.P.Q.2d 1017, 1019 (Fed. Cir. 1994).

“Molecular self-assembly has been defined as ‘the spontaneous association of molecules under equilibrium conditions into stable, structurally well-defined aggregates joined by noncovalent bonds’” (page 1, Specification). The subject invention requires that “at least two different self-assembling or self-organizing molecules are combined under self-assembly conditions to produce an initial composite structure, where the initial composite structure is a regular or ordered structure made up of the two or more self-assembling molecules” (page 5, Specification). Furthermore, “ordered structure” is defined as “an aggregate of molecules having a regular or defined order, e.g., a planar structure, a nanostructure, etc., where the constituent molecules of the composite structure are held together by non-covalent interactions” (pages 5-6, Specification). The ordered structure may be any number of disparate configurations, depending on the nature of the self-assembling molecules, and can be, for example, two-dimensional sheets,

membranes, mushroom shaped particulate nanostructures, rods, discs, stacks, cylinders, spheres, and the like (page 6, Specification).

It is noted that in the present invention, both the first and second molecules are self-assembling into an ordered structure. Bruza does not teach the use of two self-assembling molecules. The matrix precursor molecules of Bruza, which the Examiner equates to the first molecules of the present invention, are not self-assembling molecules. Throughout the reference, the matrix precursor molecules are described as a cross-linkable molecule, e.g, a thermosettable monomer. See e.g., columns 3 through 7. Furthermore, a thermosettable monomer is not taught as a self-assembling molecule.

At best, only the porogen, which the Examiner equates to the second molecules of the present invention, is taught to be a self-assembling molecule. The language cited by the Examiner from column 7, line 42 et seq. refers to using self-assembling block copolymers as porogens. "Such materials may be capable of self-assembling, as described in *Physics Today*, February 1999, p. 32, if the blocks are immiscible to give separated domains in the nanometer size range" (Bruza, Col 7, Lines 44-47).

However, Bruza does not teach the use of two self-assembling molecules that self-assemble with each other into a single composite structure. As such, Bruza does not teach every element of the present invention. In particular, Bruza does not teach the use of a first and second self-assembling molecule.

Furthermore, Bruza does not teach the formation of an ordered composite structure from first and second molecules. The Examiner looks to the examples in Bruza to teach the production of ordered structures from first and second molecules. "Illustrative examples disclose sheets and nano objects disclosed as structures obtained from the method taught by the patentee" (page 4, Office Action). However, the examples do not teach ordered structures of the subject invention.

Example 1 discloses a material made in a glass reactor, with no specific structure identified. Matrix precursor divinylsiloxane-bis-benzocyclobutene was mixed with porogen poly(propylene glycol)biscinnamate. There is no indication that the mixture formed an ordered structure. Instead, the mixture formed "a single phase" in a glass reactor (Col 14, Bruza). Furthermore, neither the matrix precursor nor the porogen is described as a self-assembling molecule. As such, Example 1 does not teach the production of an ordered structure from self-assembling first and second molecules.

Example 2 discloses a material coated onto a 4 inch silicon wafer. Matrix precursor divinylsiloxane-bis-benzocyclobutene was mixed with porogen poly(propylene glycol)biscinnamate. The mixture was puddled onto a silicon wafer and spun to create a thin film of material. There is no indication that the mixture formed an ordered structure. Furthermore, neither the matrix precursor nor the porogen is described as a self-assembling molecule. As such, Example 2 does not teach the production of an ordered structure from self-assembling first and second molecules.

Example 3 discloses a 1.16 micrometer thick coating of a material on a silicon wafer. Matrix precursor solution of 4,4'-bis(2,4,5-triphenylcyclopentadien-3-one)diphenyl ether and 1,3,5-tris(phenylethynyl)benzene was mixed with porogen polystyrene ester of 3,5-bis(phenylethynyl)benzoic acid. The solution was applied to a silicon wafer and cast by spin-coating to make the thin coating. There is no indication that the mixture formed an ordered structure. Furthermore, neither the matrix precursor nor the porogen is described as a self-assembling molecule. As such, Example 3 does not teach the production of an ordered structure from self-assembling first and second molecules.

Example 4 discloses several structures, including: (a) a 3.5 micrometer thick coating on silicon wafer, (b) a 3.3 micrometer coating on silicon wafer, (c) a 5.8 micrometer thick coating on silicon wafer, (d) a 1.85 micrometer thick

coating on a silicon wafer, (e) 0.9 micrometer thick coatings on four silicon wafers, and (f) a 2.2 micrometer thick coating on a silicon wafer.

(a) Matrix precursor solution of 4,4'-bis(2,4,5-triphenylcyclopentadien-3-one)diphenyl ether and 1,3,5-tris(phenylethynyl)benzene was mixed with porogen anionically polymerized polystyrene. The mixture was spin-coated onto a silicon wafer to give the thin film. There is no indication that the mixture formed an ordered structure. Furthermore, neither the matrix precursor nor the porogen is described as a self-assembling molecule. As such, this embodiment does not teach the production of an ordered structure from self-assembling first and second molecules.

(b) The same solution of molecules from (a) above were spun on a silicon wafer to give a thinner coating. For the same reasons, this embodiment does not teach the production of an ordered structure from self-assembling first and second molecules.

(c) The same solution of molecules from (a) above were spun on a silicon wafer to give a thicker coating. For the same reasons, this embodiment does not teach the production of an ordered structure from self-assembling first and second molecules.

(d) Matrix precursor solution of 4,4'-bis(2,4,5-triphenylcyclopentadien-3-one)diphenyl ether and 1,3,5-tris(phenylethynyl)benzene was mixed with porogen anionically polymerized polystyrene, which porogen is different from that used in (a) above. The mixture was spin-coated onto a silicon wafer to give the thin film. There is no indication that the mixture formed an ordered structure. Furthermore, neither the matrix precursor nor the porogen is described as a self-assembling molecule. As such, this embodiment does not teach the production of an ordered structure from self-assembling first and second molecules.

(e) Matrix precursor solution of 4,4'-bis(2,4,5-triphenylcyclopentadien-3-one)diphenyl ether and 1,3,5-tris(phenylethynyl)benzene was mixed with

porogen anionically polymerized polystyrene, which porogen is different from that used in (a) above. The mixture was spin-coated onto four silicon wafers to give the thin films. There is no indication that the mixtures formed an ordered structure. Furthermore, neither the matrix precursor nor the porogen is described as a self-assembling molecule. As such, this embodiment does not teach the production of an ordered structure from self-assembling first and second molecules.

(f) Matrix precursor solution of 4,4'-bis(2,4,5-triphenylcyclopentadien-3-one)diphenyl ether and 1,3,5-tris(phenylethynyl)benzene was mixed with porogen star polystyrene. Star polystyrenes represent a special case of branched macromolecules, distinguished by a structure comprising several chains radiating from a relatively compact hub. Star polystyrenes are not ordered structures, but instead are individual monomers that have a star shape. The mixture was spin-coated onto a silicon wafer to give the thin film. There is no indication that the mixture formed an ordered structure. Furthermore, neither the matrix precursor nor the porogen is described as a self-assembling molecule. As such, this embodiment does not teach the production of an ordered structure from self-assembling first and second molecules.

None of the embodiments of Example 4 teach the production of an ordered structure from self-assembling first and second molecules.

Example 5 discloses a 1.5 micrometer coating of a material on a silicon wafer. Matrix precursor solution of 4,4'-bis(2,4,5-triphenylcyclopentadien-3-one)diphenyl ether and 1,3,5-tris(phenylethynyl)benzene was mixed with porogen polyamide endcapped with 3,5-bis(phenylethynyl)benzamide. The mixture was spin-coated onto a silicon wafer to give the thin film. There is no indication that the mixture formed an ordered structure. Furthermore, neither the matrix precursor nor the porogen is described as a self-assembling molecule. As such, Example 5 does not teach the production of an ordered structure from self-assembling first and second molecules.

Example 6 discloses a 2.7 micrometer coating of a material on a silicon wafer. Matrix precursor solution of 4,4'-bis(2,4,5-triphenylcyclopentadien-3-one)diphenyl ether and 1,3,5-tris(phenylethynyl)benzene was mixed with porogen cross-linked latex solutions, e.g., DW-110NA latex from Dow Chemical. The mixture was spin-coated onto a silicon wafer to give the thin film. There is no indication that the mixture formed an ordered structure. Furthermore, neither the matrix precursor nor the porogen is described as a self-assembling molecule. As such, Example 6 does not teach the production of an ordered structure from self-assembling first and second molecules.

Example 7 discloses a 1.6 micrometer coating of a material on a silicon wafer. Matrix precursor solution of 4,4'-bis(2,4,5-triphenylcyclopentadien-3-one)diphenyl ether and 1,3,5-tris(phenylethynyl)benzene was mixed with porogen Boltron H40 Benzoate and 1,2,3,4-Tetrakis(phenylethynyl)benzene. The mixture was spin-coated onto a silicon wafer to give the thin film. There is no indication that the mixture formed an ordered structure. Furthermore, neither the matrix precursor nor the porogen is described as a self-assembling molecule. As such, Example 7 does not teach the production of an ordered structure from self-assembling first and second molecules.

Example 8 discloses (a) a 1.94 micrometer coating and (b) a 2.84 coating of a material on silicon wafers.

(a) Matrix precursor solution of 4,4'-bis(2,4,5-triphenylcyclopentadien-3-one)diphenyl ether and 1,3,5-tris(phenylethynyl)benzene was mixed with porogen poly(styrene-block-methyl methacrylate). The mixture was spin-coated onto a silicon wafer to give the thin film. There is no indication that the mixture formed an ordered structure. Furthermore, neither the matrix precursor nor the porogen is described as a self-assembling molecule. As such, this embodiment does not teach the production of an ordered structure from self-assembling first and second molecules.

(b) Matrix precursor solution of 4,4'-bis(2,4,5-triphenylcyclopentadien-3-one)diphenyl ether and 1,3,5-tris(phenylethynyl)benzene was mixed with porogen poly(butadiene-block-b-caprolactone). The mixture was spin-coated onto a silicon wafer to give the thin film. There is no indication that the mixture formed an ordered structure. Furthermore, neither the matrix precursor nor the porogen is described as a self-assembling molecule. As such, this embodiment does not teach the production of an ordered structure from self-assembling first and second molecules.

None of the embodiments of Example 4 teach the production of an ordered structure from self-assembling first and second molecules.

Example 9 discloses a material coated onto a four inch silicon wafer. Matrix precursor divinylsiloxane-bis-benzocyclobutene was mixed with porogen polyamidoamine dendrimer. The mixture was spin-coated onto a silicon wafer to give the thin film. There is no indication that the mixture formed an ordered structure. Furthermore, neither the matrix precursor nor the porogen is described as a self-assembling molecule. As such, Example 9 does not teach the production of an ordered structure from self-assembling first and second molecules.

Example 10 discloses a 2.5 micrometer coating of a material on a silicon wafer. Matrix precursor solution of 4,4'-bis(2,4,5-triphenylcyclopentadien-3-one)diphenyl ether and 1,3,5-tris(phenylethynyl)benzene was mixed with porogen 8-arm star poly(ethylene glycol) benzoate. The mixture was spin-coated onto a silicon wafer to give the thin film. There is no indication that the mixture formed an ordered structure. Star polymers are not ordered structures. Furthermore, neither the matrix precursor nor the porogen is described as a self-assembling molecule. As such, Example 10 does not teach the production of an ordered structure from self-assembling first and second molecules.

Example 11 discloses a 4.7 micrometer coating of a material on a silicon wafer. Matrix precursor solution of 4,4'-bis(2,4,5-

triphenylcyclopentadien-3-one)diphenyl ether and 1,3,5-tris(phenylethynyl)benzene was mixed with porogen polystyrene ester of 4-phenylethynylbenzoic acid. The mixture was spin-coated onto a silicon wafer to give the thin film. There is no indication that the mixture formed an ordered structure. Furthermore, neither the matrix precursor nor the porogen is described as a self-assembling molecule. As such, Example 11 does not teach the production of an ordered structure from self-assembling first and second molecules.

Example 12 discloses a material coated onto four inch silicon wafers. Matrix precursor perfluorocyclobutene was dissolved in mesitylene and swelled with different concentrations of styryl-benzocyclobutene. The mixture was spin-coated onto a silicon wafer to give the thin film. There is no indication that the mixture formed an ordered structure. Furthermore, neither the matrix precursor nor the swelling solution is described as a self-assembling molecule. As such, Example 12 does not teach the production of an ordered structure from self-assembling first and second molecules.

As such, none of the examples teach the production of an ordered structure, much less from first and second self-assembling molecules. Accordingly, Bruza does not anticipate the present invention and objections to Claims 1-2, 5-11, and 13-20 under 35 U.S.C. § 102 (e) may be withdrawn.

Rejection Under 35 U.S.C. § 103 (a)

Claim 5 is rejected under 35 U.S.C. § 103 (a) as being unpatentable over Bruza. The Examiner asserts that the reference expressly teaches that the pore size in the preferred embodiments does not exceed 10 nm, thus rendering the claim's diameter of 5 nm obvious. Applicants assume the Office Action has made a typographical error; this rejection is a rejection of Claim 4, which includes the diameter limitation of 5 nm, and not Claim 5, which does not address the pore diameter.

It is accepted that a proper prima facie obviousness rejection must be based on a combination of references that, among other requirements, teach or suggest all of the claim limitations. M.P.E.P. § 2143 states in relevant part:

To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings. Second, there must be a reasonable expectation of success. **Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.**

Thus, a valid prima facie case of obviousness requires a teaching or suggestion by the combined references of each and every limitation of the claimed invention.

In view of the above remarks under the § 102(e) rejection, Bruza does not teach every limitation of Claim 4. Namely, Bruza does not teach the method of Claim 1, upon which Claim 4 is dependent. As argued above, Bruza does not teach combining first and second molecules that will self-assemble into an ordered composite structure. Accordingly, the objection to Claim 4 under 35 U.S.C. § 103(a) may be withdrawn.

Additionally, the cited reference does not render obvious any of the subject claims. Bruza does not suggest or motivate combining first and second molecules that will self-assemble into an ordered composite structure. Bruza is directed towards thinly coating substrates, e.g., silicon wafers, and the like, with an ultra-low dielectric constant material. See Col 2, Summary of the Invention ("The material is preferably in the form of a thin film on a substrate.") and Col 11, Lines 33-43. Thus, Bruza teaches coating a substrate with a composite mixture of a matrix precursor and a porogen. Bruza does not suggest or motivate the use of an ordered composite structure that forms independently of some substrate. Use of such an ordered composite structure would unnecessarily complicate Bruza's method because Bruza's composite is a mixture that is applied as a thin film on some substrate. The composite mixture obtains its ultimate structure from the

substrate which serves as a scaffolding. Nothing in Bruza suggests the present invention of an ordered composite structure.

In addition to and because Bruza does not suggest or motivate the use of an ordered composite structure, Bruza does not suggest the use of self-assembling first and second molecules. Bruza describes the matrix precursors, which the Examiner equates to the first molecules of the present invention, as cross-linkable molecules, i.e., "Cross-linkable--refers to a matrix precursor that is capable of being irreversibly cured, to a material that cannot be reshaped or reformed. Cross-linking may be assisted by UV, microwave, x-ray, or e-beam irradiation. Often used interchangeably with "thermosettable" when the cross-linking is done thermally" (Col. 2, Definitions). Bruza does not suggest the use of a self-assembling molecule as the matrix precursor. At best, Bruza suggests that the porogen self-assembles into pores within an unstructured, cross-linked matrix film. In no way does Bruza suggest that the porogen self-assembles with the matrix precursor into an ordered structure held together by non-covalent bonds. Doing so would be unnecessary to the stated method of applying the composite mixture onto a substrate as a thin film.

Thus, Bruza fails to suggest or motivate the combining of first and second molecules that will self-assemble into an ordered composite structure held together by non-covalent bonds. Accordingly, Bruza would not support an obviousness rejection of any of the present claims.

CONCLUSION

In view of the above remarks, this application is considered to be in good and proper form for allowance and the Examiner is respectfully requested to pass this application to issuance.

If the Examiner finds that a telephone conference would expedite the prosecution of this application, please telephone Timothy Joyce at 650-485-4310. The Commissioner is hereby authorized to charge any underpayment of fees associated with this communication, including any necessary fees for extensions of time, or credit any overpayment to Deposit Account No. 50-1078.

Respectfully submitted,
BOZICEVIC, FIELD & FRANCIS LLP

Date: 8/9/05

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- Replacement Figure

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In the Drawings

Please replace Figure 2 with the enclosed substitute Figure 2, which is amended to remove a vinyl group from molecule 5. The portion of molecule 5 that is amended is the block group that is derived from molecule 3B.

Enclosure: Replacement Figure 2.